DOCUMENT RESUME

ED 353 733 EC 301 764

AUTHOR Askov, Eunice N.; And Others
TITLE Adult Literacy, Computer Technology, and the Hearing Impaired.
PUB DATE May 89
NOTE 42p.; In: Literacy and the Hearing Impaired Conference Proceedings (Washington, DC, May 18-20, 1989); see EC 301 760.
PUB TYPE Speeches/Conference Papers (150) -- Information Analyses (070)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS Adult Education; *Adult Literacy; American Sign Language; *Computer Assisted Instruction; Computer Oriented Programs; Educational Needs; Educational Technology; English (Second Language); Functional Literacy; *Hearing Impairments; *Literacy Education; Reading Instruction; Research Needs; Technological Advancement; Whole Language Approach; Writing Instruction; Writing Processes

ABSTRACT

This paper looks at computer technology's current and potential role in developing literacy in hearing impaired (HI) adults. First, the paper considers findings of adult literacy research including the national impact of illiteracy, functional literacy, communication and thinking skills, the whole language approach, the process approach to writing, and functional context instruction. Second, the specific literacy needs and skills of the HI population are reviewed. Considered are the need for improved literacy levels for HI adults, characteristics of HI adults, language development, American Sign Language and English as a Second Language, bilingual instruction, and benefits of literacy programs for HI adults. Third, the use of technology in adult literacy programs is discussed, covering the novelty of technology, advantages and disadvantages of using computer technology, development of computer technology for the hearing impaired, technology implementation in educational programming, and availability and development of computer software. Recommendations include: (1) further research and development applying findings in adult literacy to the special needs of the hearing-impaired population; (2) careful evaluation of the effectiveness of pilot projects; (3) teacher training and technical assistance in computer technology; and (4) communication with ongoing projects and organizations to share information. (Contains 68 references.) (DB)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)
☑ This document has been reproduced as received from the person or organization originating it
☐ Minor changes have been made to improve reproduction quality
• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy

ED353733

ADULT LITERACY, COMPUTER TECHNOLOGY, AND THE HEARING IMPAIRED

By

Dr. Eunice N. Askov
Mary J. Kisner
Barbara L. VanHorn

Institute for the Study of Adult Literacy
The Pennsylvania State University

1989 Institute for the Study of Adult Literacy
The Pennsylvania State University

EC 301 764

BEST COPY AVAILABLE

ABSTRACT

Research shows that computer-assisted instruction can assist the hearing impaired adult learn basic literacy skills. Unfortunately, although computer technology is advancing rapidly, software development for teaching literacy skills to the hearing impaired adult is in its infancy. While there are a few programs available for this purpose, they have not been rigorously evaluated for effectiveness and appropriateness. Recommendations include: 1) further research and development, building on current research in adult literacy and applying it to the hearing impaired population; 2) careful evaluation of the effectiveness of pilot projects; 3) teacher training and technical assistance in computer technology; and 4) communication with ongoing projects and organizations across the country to share information.

INTRODUCTION

We would like to consider today how technology, especially computer-assisted instruction (CAI), can assist the hearing impaired (HI) adult in learning basic literacy skills. Three topics will be explored to provide background for this discussion. First, adult literacy research, in general, addresses many issues of concern for the HI population. Second, the literacy needs and skills of the HI population specifically must be considered. And third, the use of technology in adult literacy programs in general will give direction to the question at hand. The review of literature in these areas provide only a brief summary of some of the research and should not be considered comprehensive. [See

Appendix for a more extensive overview of Adult Literacy.]

- 1989, Institute for the Study of Adult Literacy
The Pennsylvania State University

Adult Literacy

National Impact of Illiteracy

Illiteracy is an issue of critical national and international concern. The statistics are alarming; as many as 27 million adults in this country are unable to participate fully in our democratic, social, and economic systems because of illiteracy (Harman, 1985, 1987). An additional 2.3 million persons are added to this group each year through immigrants and high school dropouts (McCune and Alamprese, 1985). Illiteracy affects many aspects of our lives; however, two issues are of special concern: the effect of illiteracy on our economy and its inter-generational effect on families. Lost productivity is one of the most generally recognized cost of basic skills deficiency. In 1986 the United States Congress, Office of Technology Assessment reported that lack of basic skills in the workforce "may manifest itself in sluggish productivity growth, increased needs for supervision, and deficient product quality. These costs are difficult to quantify but are probably substantial" (Collino, Aderman, & Askov, 1988, p.13).

Additionally illiteracy is often inter-generational; low-literate adults are unable to promote essential pre-reading skills in their young children (Kirsch & Jungeblut, 1986; Thompson, 1985; Segalman, 1981). Less educated homes offer fewer opportunities

for the preschool child to observe role models performing reading tasks and to listen to extended, elaborated spoken discourse like that found in the schools (Anderson, Hiebert, Scott, Wilkinson, 1984; Sticht, 1987). Even more important is the impact of illiteracy upon the quality of life for those individuals. A functionally illiterate person cannot participate fully in society and make independent decisions as a worker, citizen, parent, and consumer. Although illiteracy cuts across all socioeconomic groups, the poor and racial and ethnic minorities are most often affected.

Functional Literacy

Literacy in its simplest definition, is the ability to read and write. Definitions of functional literacy, however, address the more complex issues relating to the ability to complete tasks as defined by the environment. Harman (1985) for example, defines functional literacy as including not only the ability to read and write but also the possession of knowledge and skills which enable an individual to function effectively in his/her environment. An individual's interest and participation in literacy programs is determined most often by the person's immediate needs and interests, such as getting a job or helping a child with homework. In other words, a person must perceive literacy as personally useful. Once integrated into the person's life, literacy skills can become effective tools in coping with daily concerns in the home, community, and workplace.

Various studies have measured the functional literacy levels

of adult populations. The 1985 National Assessment of Educational Progress (NAEP) study concludes that most of America's young adults between the ages of 21 and 25 can read and understand the printed word. Unfortunately, many of these same adults are unable to perform well on literacy tasks of moderate and more challenging complexity. This is a disturbing conclusion considering the increasing complexity of modern society. Kirsch and Jungeblut (1986) and Venezky, Kaestle, and Sum (1987) report that within the next decade the young adult population will be composed of increasing proportions of minorities and those who have completed less than twelve years of school--many of whom will be seriously lacking in complex literacy skills.

As interest in adult literacy has grown, concern about how best to meet the needs of the low- literate adult through appropriate teaching methods and curriculum materials has also grown. This concern is reflected in questions such as: What basic skills should be taught? How should they be taught? What approaches are effective? How do we meet the information needs of adults? How can we help adults see the usefulness of literacy?

Communication and Thinking Skills

Although reading, writing, and math have been generally recognized as the three basic skills, recent research indicates that thinking is a fourth basic skill and possibly is the most important (Goudreau, 1986; Presseisen, 1986). We are concerned today with the basic skills of reading, writing and thinking which are essential for effective communication.

Proficient, independent readers are those who are able to recognize many words quickly without having to analyze them (word recognition skill). They are also able to understand the meanings of those words when seen either in isolation or in the context of a written passage (comprehension skill). As reading tasks become more complex, the proficient reader is able to use additional strategies (thinking skills) in order to evaluate, integrate, and assimilate newly learned information. Presseisen cites four types of complex thinking processes: problem solving, decision making, critical thinking, and creative thinking. While one could argue that other skills might be included, these most fundamental processes should be applied in various relevant content areas. In the case of the adult student, application in daily living and in the workplace is of critical importance.

In addition to relevance and applicability, adult instruction should include the development of metacognitive skills. Students become confident in their abilities to solve problems and find answers, because they have learned to think through problem solving situations. Development of metacognitive thinking skills can be taught directly, according to most researchers, and most effectively within the context of learning new content.

Reading and writing, the fundamental basic skills building blocks, are integrated and reinforced through communication and thinking skills instruction. The ability to think critically and to communicate effectively are essential if adults are to participate more fully in community activities and in the civic processes

fundamental to a democratic society.

Whole Language Approach

Since many adult beginning readers have difficulty in moving beyond simple word recognition skills to the more complex skills involved in comprehension and problem-solving (Chall, 1984), it seems obvious that programs must be developed which will enable low-literate adults to improve the complex skills of reading comprehension, writing and critical thinking skills. It is important that critical thinking be taught through the combined use of all types of communication--listening, speaking (signing), reading, and writing--in other words, a whole-language approach (Goudreau (1986; Presseisen, 1986). These critical thinking skills are the same skills needed for success in the workplace. In fact, Askov and Otto (1985) conclude that reading and writing are parallel ways of processing written language and also parallel the creative thought process. Instructional approaches, therefore, which teach reading and writing together provide a natural setting in which to teach other complex skills. This approach allows instructors to build on the strong relationship that exists between reading and writing (Goodman and Goodman, 1981; Rubin and Hansen, 1985).

Process Approach to Writing

One way to integrate reading, writing and critical thinking is through the process approach to writing. The process approach to teaching writing is effective with children in improving their reading and writing (Applebee, Lehr, and Auten, 1981; Graves, 1983;

Howard and Barton, 1986; Kean, 1983; Murray, 1984; Myers, 1984). In the process approach, teaching focuses on the process of developing writing rather than on the product. Students are guided through the steps of rewriting (brainstorming ideas), learning appropriate vocabulary, composing the writing sample concentrating on content rather than mechanics (spelling, punctuation), sharing the writing with other students to generate ideas for revisions., editing the writing focusing on mechanics and clarity, and, finally, publishing the final writing.

This method has not been widely used with low literate adults. The Institute for the Study of Adult Literacy, however, is currently adapting the process approach for adults. The process is being used with older displaced workers and trained tutors who use a word processor to produce student generated writing. The writing samples are shared with other student/tutor pairs via computer discs. Although further research is needed, it appears that an instructional approach that teaches basic skills in an integrated way and with meaningful content is most effective method of teaching adults.

Functional Context Instruction

The concept of functional context instruction (Sticht, 1987) has made an important contribution to adult reading instruction. Basic skills that are essential to performing a job are identified and then taught within the functional context of the job so that the adult not only learns the basic skills that are important to performing the job well but also masters the content knowledge

associated with the job. Job-related basic skills instruction has been proven to be more effective in enhancing productivity on the job than general basic skills instruction offered by commercial materials (Sticht, 1987). Although Sticht's research is based on workplace settings, the same approach can be used effectively in other environments where relevant content serves as the context for instruction in basic skills. For example, parents may practice English communication skills in the functional context of learning strategies for improving their children's success in school.

Adult Literacy and the Hearing Impaired

Need for Improved Literacy Levels for HI Adults

The definitions of functional literacy when applied to special needs populations must take into consideration the unique characteristics of the special population. Today, of course, we are focusing on the special needs of HI adults. A person with a hearing loss is placed under considerable strain to cope with a culture in which the primary mode of communication is through spoken language. Psychologically, the hearing impaired individual must cope with the frustrations of trying to communicate and understand what the outside world is trying to convey (Hewitt, 1978). In addition to the psychological barriers, rapid changes in modern technology have increased the need for more literate individuals. HI adults are forced to have higher levels of literacy than ever before to cope successfully with modern society. Early in this century only a minimal level of literacy was expected of most people; however, Jean Chall (1984) estimates that a minimum

literacy level of twelfth grade is needed to cope effectively with the literacy expectations of today's society. In view of rising literacy demands, it is increasingly important for low-literate HI adults to acquire both basic and more complex English literacy skills in order to become active, contributing participants of society.

Characteristics of HI Adults

Adults with disabilities have most of the same behaviors, attitudes and perceptions pertaining to learning as any other group of adult learners, according to Dr. Mary Carter-Williams (1988), Director of Continuing Education at Howard University School of Communications. "But they bring many different learning styles and experiences, so that no general model is applicable to all those with disabilities. Some may have had previous experiences that were not positive, and they face emotional factors such as anxiety, fear and general barriers" (p. 4).

Dequin & Johns (1986), emphasizes that for both learning and entertainment, visual media are best in helping the hearing impaired learn. When dealing with HI adults we must consider two important factors: 1) the HI adult has had a variety of life experiences on which to build, and 2) the HI adult, who cannot read or write, has had a variety of negative experiences of failure to learn in the traditional way at the usual time. HI adults usually lack the normal language experiences of hearing individuals which, in turn, limits their life experiences.

Joan Ehrlich (1988), former coordinator of Adult Basic

Education at Gallaudet University, reiterates this belief by stating that deaf adults can be different and have unique characteristics; but, in some ways, they are the same as all adult learners. She also describes: factors affecting how a person with hearing loss will learn, including whether the family is hearing; how the family reacts to the person's deafness; whether it is accepting or has a problem with the hearing loss; whether the person has attended a public school or special school and learns sign language; and whether the person was born with the ability to hear, later losing the ability to hear or was born deaf, indicating a different type of development (p. 10).

Language Development

Hearing children's experiences with oral speech and an oral culture allow them to develop a conceptual knowledge of word meaning and linguistic style enhances reading development (Webster, 1986). "The typical...hearing child brings to the reading task a rich background of experiential, cognitive, and linguistic skills. These pre-reading skills and knowledge provide the base for the development of reading (King and Quigley, 1985).

The child with a hearing disability will not develop linguistically in the same manner as the normal hearing child. If the hearing loss is severe, the child risks greater deprivation in areas of emotional, social and educational development. "Since reading ability is highly correlated with prior English knowledge, many students who are deaf...have difficulty becoming proficient readers" (Commission on Education of the Deaf, 1988).

King and Quigley (1985) describe the problems related to teaching reading to hearing impaired children. "The typical deaf child lacks [a rich background of experiential, cognitive, and linguistic skills]. It follows from this alone that the deaf child will have great difficulty learning to read and that the reading process will be entangled with the basic primary language-learning process and with the cognitive and experiential deficits of the deaf child." Webster (1986), asserts that deafness is not just a deprivation of sound but a deprivation of language, and that difficulties in language development and reading skills follow hearing impaired children through the high school years into adulthood. Since the Commission on Education of the Deaf (1988) suggested that "95 percent of [deaf individuals] are deaf at birth or lose their hearing before they have acquired English or other spoken language skills," it is not surprising that pre-lingually deaf adults have about a third grade reading level (Trybus, R. J. & Karchmer, M. A., 1977).

ASL and ESL

Because reading and writing are based on the need to communicate with an already learned spoken language the HI adult doesn't have this motivation. However, the HI adult does have a language which is rich in expression and emotion. A gesture or sign can have many meanings, determined by the expression on the face, the speed of delivery, and location in relation to the body. Lacking experience in hearing the spoken word, communication skills develop along other lines.

Many of the deaf use American Sign Language (ASL). ASL is often the first language to which hearing-impaired adults are exposed. Although ASL is as complex and expressive as English, there are distinct differences in syntax, grammar, and vocabulary; ASL, therefore, cannot be easily translated into written English in the way that hearing individuals read and understand it (Commission on Education of the Deaf, 1988). As a result, children and adults who use ASL are confronted with learning English as a Second Language (ESL) when they enter school.

Research into first language (L1) acquisition shows that children develop competence first in listening and then in speaking before they are prepared for exposure to formal instruction in reading and writing (Prewitt-Diaz, 1985; Sticht, 1987). The development of these competencies in oral language are critical to the development of competence in written language. Recent studies in second language (L2) acquisition also conclude that developing listening comprehension skills in the second language is critical to the development of oral proficiency and literacy (reading and writing) skills in that language (Potovsky, 1981; Winitz, 1981; Dunkel, 1986). Some instructional methods, such as English as a Second Language, High Intensity Language Training, Sheltered English, and Structured Immersion, use only English to teach language skills.

It is obvious then that learning English as a second language depends largely in listening proficiency. HI adults obviously cannot benefit from instruction that focuses on listening to

English. Perhaps a more successful approach will be a bilingual instructional approach.

Bilingual Instruction

Bilingual instruction incorporates the first language, in this case ASL, into English language instruction. Instructional methods may stress the development of English skills or the development of both English and the native language. Bilingual instruction teaches English using the student's native language skills to develop English language skills. These programs depend in part on identifying specific reading and writing skills common to both languages and those skills unique to each language. The instructor teaches and reinforces skills in the native language and prepares students to transfer skills acquired in the native language to English (Prewitt-Diaz, 1985). Obviously one of the problems in using this approach with HI adults is its dependence on using reading and writing skills in both languages, and ASL is not a written language.

In developing appropriate instructional methods it is important to remember that 1) HI adults are adults, regardless of their special learning needs; 2) deafness, especially pre-lingual deafness seriously affects HI adults' ability to learn English reading/writing skills; and 3) HI adults whose first language is ASL must learn English as a second language.

Benefits of Literacy Programs for HI Adults

Gallaudet Adult Basic Education programs and others are being innovative in developing literacy programs for HI adults. HI

adults benefit from literacy programs in the same ways that all education programs and services assist their participants (Gallaudet, 1987). They may increase their level of functioning, by being able to read better, or understand more. They may also benefit by increasing their self- confidence and awareness of their strengths and weaknesses. Hearing impaired adults who participate in literacy programs also benefit from increased opportunities for social interaction. This gives them the opportunity to apply and practice, in informal situations, the skills that they have learned in the more formal classroom environment. Adults who participate in literacy programs have not, for various reasons, previously benefitted from formal education programs. Literacy programs for persons who are deaf provide a safe and nurturing atmosphere in which they can interact with capable experts with whom they can work toward their goals and expectations, and peers with whom they can share their hopes, fears, and dreams.

Adult Literacy and Computer Technology

The Novelty of Technology

Many new methods for teaching have come under the guise of technology. In independent learning centers in the 60s, we found filmstrips and film loops the "way" to let the student learn at his own pace. Later, every classroom had a TV; but, initially, programming was inadequate and boring, and classrooms had to plan their day around the 2 p.m. science lesson. The VCR has helped free the teacher to use TV without being a slave to the schedule. But, according to Paul Welliver at Penn State, who helped pioneer

science on TV, researchers found subjects like science really could not be taught on TV. Science is a process approach of discovery and students needed hands on activities.

When the first computers were introduced to the classroom, the novelty also created great excitement. When the novelty wore off, the limitations of the software were evident. However, innovative programming in the last several years now allow the user to be creative as an artist or a writer. To be the creator of something gives an individual a sense of power. Programming has matured to the point where the computer can be a patient teacher, branching to new information when the student is ready. Or the computer can provide the tools for the student to express himself in words or pictures.

In this way, the computer can now help provide the motivation for a student to reach out. It is especially appealing to adult learners because it is an "adult" tool. Other adults use computers to do their work. CAI offers a face-saving way to learn basic skills in a way different from school learning. Many under-educated adults have not had positive experiences with schooling. Using computers allows adults to learn basic skills in new ways--so that they don't have to relive experiences with frustration, failure, and humiliation that they may have endured as children in school. Computers also offer other advantages, summarized by Askov & Turner (1989):

Advantages of Using Computer Technology

1) Privacy - Only the adult and his/her teacher or tutor

needs to know the actual level that the learner is working on.

2) Individualization - Instruction can be tailored to the adult student's needs rather than to those of the group. The teacher can individualize not only the pace of learning but also the content and presentation to the needs and interests of the individual adult student.

3) Achievement gains - Some research studies have demonstrated better than average gains through use of computer technology (Askov, 1986; Askov, Maclay, & Bixler, 1987; Maclay & Askov, 1987; Maclay & Askov, 1988). Clark (1983), however, cautions that achievement gains may not be due to the medium of instruction--that research variables are often confounded. Whether these gains can be maintained over time or whether the skills, once acquired through using computer technology, can be transferred to daily life and retained requires further research. We can say with some degree of certainty, however, that adult students learn more rapidly using computer technology.

4) Cost Effectiveness - An extensive evaluation (Turner & Stockdill, 1987) of an urban technology/literacy center has revealed that delivering instruction through computer technology is no more expensive than traditional instruction with advantages in achievement gains. In fact, more students than originally anticipated could be served through using computers.

5) Control of learning - The adult student gradually takes control of the learning situation as he/she learns how to use the computer. This control of one's own learning processes is perhaps

the most compelling reason to use computers.

6) Flexibility in scheduling - Adults have busy schedules. Literacy classes have to be worked in among job assignments and family activities. Drop-in centers using computers offer flexibility to adults that children in school programs don't require. While this technology may not eliminate the need for group class instruction, it can offer opportunities for instruction in a student's open time slots.

7) Open entry-open exit - Adult education teachers and tutors are well acquainted with the need to accommodate adults whose job schedules change frequently and whose turbulent lives seem to resist regular schedules. Adults frequently drop in and out of programs; computer technology enables teachers and tutors to start where students left off, saving valuable time for both.

8) Modern way to learn - Computers are revolutionizing the workplace; business/industry/labor organizations look to technology to upgrade the learning skills of workers. A certain faith in computer technology exists in the modern mind (Turkle, 1984). This faith can help adult students overcome feelings of inadequacy as they approach the task of learning basic skills as adults (Lewis, 1988).

9) Authoring capability - A creative teacher or tutor may tailor instruction to the needs and interests of the individual student. Bixler & Askov (1988) describe how volunteer tutors were able to create vocabulary lessons geared to the job-preparation needs of displaced homemakers enrolled in a literacy council's

basic skills program until they were qualified to enter a job-training program. Teacher creation options can give teachers and tutors viable and important roles in the use of technology.

Susan Imel, (1989), director of the ERIC Clearinghouse on Adult, Career, and Vocational Education, reminds us that CAI has not been effective with all learners. Some of the problems that can be encountered with computer technology must now be considered.

Disadvantages of Using Computer Technology

Askov & Turner (1989) list several disadvantages, but most relate to the computer hardware. As hardware becomes more sophisticated and user friendly these disadvantages can be overcome. The other disadvantages relate to appropriate implementation training for the teachers.

1) Change - Computer technology is constantly changing. What seemed "state of the art" several years ago is now "primitive." Continual upgrading is necessary to take advantage of the best that technology has to offer (Turner, 1988).

2) Lack of compatibility - Particularly a problem with computer technology, lack of compatibility among machines makes identification and use of appropriate software difficult.

3) Cost - Cost used to be a major barrier to purchasing computers for instruction. Fortunately, costs have come down often making it affordable even to literacy councils which are typically under-funded.

4) Pressure to make rapid decisions - Money for computers sometimes results from an unexpected "windfall," leaving little

time to make informed decisions. Instead of careful planning which should precede innovation, administrators must "use it or lose it;" they may fall prey to a sharp salesperson who may not have the best interests of students in mind.

5) Lack of expertise - A trained resource person needs to be available to set up the equipment, fix malfunctions when they occur, and most importantly, train teachers and tutors in the use of the systems. This resource person also needs to keep up with what is happening not only in computer technology but also adult literacy to keep equipment upgraded and materials current.

6) Inappropriate instruction - Most computer software is designed for children. It may be used with adults with adaptations and care in the way it is presented. As more funding is becoming available for adult instructional programming, vendors will be producing more appropriate materials. Adult educators need to be proactive in making the needs of their students known to vendors.

7) Curriculum integration - It takes time for any innovation to be adapted and adopted in a local program. Similarly, use of a new technology is often viewed as a special event rather than part of the ongoing curriculum. Teachers must become so familiar with the instructional materials offered via the technology that these materials can become part of the instructional choices routinely available to students.

8) Lack of training - Unfortunately when program administrators decide to adopt any technology, especially computers for instruction, usually the first consideration is hardware and then

software. Only after those decisions are made does the realization come that teachers and tutors need to be trained. Instead of training being the first step, it is often an afterthought when the "miracles" of modern technology don't happen automatically.

9) Zenophobia - Zenophobia, fear of the unknown, can result from inadequate training. Teachers and tutors who are inexperienced with computers may be reluctant to use it. This reluctance is transmitted to the adult students who usually are not confident in their abilities anyway (Askov & Brown, 1988). Upfront training time for teachers and tutors can eliminate anxieties; confidence instead of fear is transmitted to students.

10) Role changes - When students use computers, and have control over their personal learning agendas, they become more independent, even self-actualizing. Sometimes teachers and tutors feel displaced, especially tutors who derive satisfaction from one-to-one instruction, and may resist using the new technology. Their role has changed; it's not any less important, but different. Training can overcome these feelings of displacement and give tutors a viable and important role in instruction (Bixler & Askov, 1988).

Why Bother With Computer Technology At All?

With all these considerations and cautions, you may be wondering why programs choose to use computers at all. While they do necessitate extensive training for staff and volunteers, that training has positive effects. Adopting computer technology offers possibilities for staff revitalization. Additional training

upgrades the quality of the staff. Most importantly, adoption of computer technology forces teachers, tutors and administrators to rethink what they are doing; it requires that they review the whole curriculum to determine how computer technology best fits (see also, Papagiannis et al., 1987). Periodic review of curriculum makes sense anyway to ensure that instructional goals are still realistic and appropriate.

Perhaps the most compelling reason for using technology is the impact on students. Askov & Brown (1988), report the sense of empowerment and control over their own learning that was expressed especially by the least able readers. Research on the effectiveness of technological approaches for adults has been limited. Recent research studies (Askov, Maclay, and Bixler, 1987; Askov, 1986; Askov and Brown, 1988; Maclay and Askov, 1987; Maclay, 1986; Pastori, 1986), however, have revealed that low-literate adult grow in self-esteem and self-confidence from the use of technological approaches to education. These adults feel that they are at last part of the mainstream culture through their use of technology. Subsequently, they begin to identify with the educational goals of the mainstream culture.

The Office of Technology Assessment (1987) also reports that (CAI) is especially successful in teaching adults with the lowest literacy levels. Not only are teachers revitalized, but so are students. The positive effects of computer technology do not appear to be due to novelty alone because student's attendance records improve with use of computers (Turner & Stockdill, 1987).

Dr. Terilyn C. Turner (1989), of the Adult Literacy and Technology Steering Committee, feels that "nothing can stop the movement towards computers because, as one tutor said to her, 'Once you use them, you never go back'" (p.3).

Using technology encourages a redefinition of literacy instruction. Literacy is no longer based on the assumption that the adult learner is somehow deficient. Learning basic skills while learning to use computers becomes viewed as part of the life-long learning process. Use of computer technology is one of the new basic skills. Learning to read while learning to use computers views literacy instruction as part of the continuing education process.

Adult Literacy, Computer Technology, and the Hearing Impaired

Development of Computer Technology

Computer technology has progressed so rapidly in the last few years that even in 1985, Thorkildsen was so optimistic that he stated, "technology, at its current rate of development, could substantially reduce or completely eliminate the impact of many physical handicaps" (P. 324).

Technology does offer the possibility of a solution, especially as society becomes technologically more complex. As virtually all segments of mainstream society turn increasingly to technology, hearing impaired adults are often left behind. Hearing impaired adults who are also handicapped by low literacy are not only left behind, they are often left out. Because of their lack of basic skills, they are excluded from using technology. Because

of high cost, lack of access to equipment, and inappropriate software, they are further denied access to technology for instruction, which holds promise for making a difference in their education and in their lives.

As noted above, technological approaches can provide very effective instruction for low literate adults. Since hearing impaired adults rarely benefit from incidental learning, their acquisition of English language skills depends on direct, intentional, concentrated input (Gallaudet University, no date given). CAI would provide the perfect medium--if designed and used correctly--for developing basic word recognition and comprehension skills.

Computer-assisted instruction has been used to instruct hearing impaired children with some success. Hart-Davis (1985) concluded that CAI can be used successfully with hearing impaired children. The children learned more quickly and showed better retention of the material. Prinz (1984, 1985) conducted a series of studies using CAI with children. The studies conclude that CAI can be very successful in improving language facility and word recognition skills in hearing impaired children. Ross Spuckloss (personal communication, April 1988) indicated that studies involving the use of CAI in reading instruction for deaf teenagers had been conducted in the late 1960s by the National Technical Institute for the Deaf. More recently, the Center on Deafness in Northridge, CA has experimented with using CAI with HI adults (unpublished conference presentation, 1988); however, the results

of the program have not been adequately studied. Neither project has been adequately studied.

Benefits for Integrating CAI Into HI Curriculum

Mary Garvey (1985), outlines some of the benefits for integrating CAI into the curriculum of hearing impaired classrooms. These same benefits are mentioned by many other researchers.

1) Computers provide individual instruction - CAI can provide tireless, interesting drill work. Immediate visual feedback can provide rewards and the computer can be programmed to branch to appropriate reinforcement. (Egan, 1985; Fleharty, 1985; Garvey, 1985; Messerly, 1986).

2) Computers allow greater student independence - Students can complete their assignments at their own pace without constant teacher interaction. This independence builds confidence in students who want to be like their hearing peers (Garvey, 1985).

3) Computers increase active participation time - With individually paced lessons a student is kept on task without long waiting periods for teachers' guidance.

4) Computers reinforce the visual learner - Because feedback is visual, the hearing impaired student is rewarded immediately in a familiar way. This encourages the learning process (Egan, 1985; Garvey, 1985).

5) Computers encourage cooperation and communication - Although CAI is usually one-to-one, student to computer, experience shows students interact with other students when working on computer lessons (Garvey, 1985). The computer, with the aid of the

modem, has even allowed students to communicate with each other nationwide. Chemeketa Community College, in Salem, Oregon, has basic skills classes for their deaf students (MacDonald, 1989). These students make extensive use of computers and were the first students on campus to begin a club for communication via modem with other students nationwide. They have TTY on campus and several SuperPhones and have connected the computer to the superphone for communication between hearing and deaf students.

6) Thinking skills developed - A sixth benefit, mentioned by Fleharty (1985), is software that encourages the hearing impaired to think for themselves. Hearing impaired students learn that sometimes specific answers work, but that often many answers are equally correct. They need to use trial and error to find the results of each choice. Programs that encourage students to remember what they entered on the computer and to build on mistakes are excellent for organizational skills, memory, and reasoning.

Approach to Implementation

Boothroyd (1987), suggests some guidelines for an integrated approach to educational programming. These guidelines outline three very important facets for implementing CAI into programming for hearing impaired adults.

First, there is an urgent need for teachers of the deaf to bridge the gap between the researchers and the deaf adult to make sure needs of students are being addressed. Although it is not common with adult literacy programs in general, recent publications from Gallaudet reveal that teachers of the HI are being trained to

use computers in the classroom. In 1985, Graham reports that as little as 15 hour workshops were effective in helping educators understand the potential of computer technology. Young (1985) agreed and reported that the Rochester Institute of Technology included faculty training sessions on a regular basis. This training allowed computer-proficient faculty to serve as peer models and were a key resource in the spread of computer literacy on campus. Today, most projects include some teacher training activity before implementing computer technology. Since current software does not teach itself, this training is critical when we remember that a dedicated and knowledgeable teacher can make or break a successful program.

Second, research must move from feasibility studies to applied research. Curriculum developers and program directors must develop and implement model programs which integrate teacher training and CAI in a whole language approach. These programs should be developed with researchers as well as adult students to assure that careful evaluation takes place.

Third, software development must be written by computer specialists, literacy specialists, and hearing impaired specialists working together. Although evidence exists to support the idea that computer-assisted instruction can be used effectively with adults, much computer-assisted instruction software for teaching beginning reading has been designed for young children. This software is generally inappropriate for an older population. Additionally, commercial software usually has not been rigorously

evaluated to determine if it is more effective than conventional instruction.

Availability of Computer Software

Garvey, in 1985, reminded us that few commercial software programs were available. Those available for the hearing impaired were expensive and of limited use. Trachtenberg (1986) agreed that computer software which could be used with hearing impaired adults, except for teacher-prepared materials, was virtually impossible to find.

More recently, The Adult Literacy Technology Project (1988) funded by the Gannett Foundation, sponsored a software study to evaluate existing instructional packages for their appropriateness for low-literate adults. A review of software evaluations reveals that no instructional packages have been identified as appropriate for teaching word recognition skills to handicapped adults without adaptations. Nevertheless, the computer offers a new vehicle for instruction, especially for those whose special learning problems and needs defy conventional means.

Today, computer technology is advancing rapidly. No longer is a computer just a number cruncher or an electronic workbook. Software development is no longer the domain of just computer programmers. Today, we see software development and evaluation taking place on three levels: the commercial level, the institutional level, and the individual level.

Commercial Development

On the commercial level, **Apple Computer** has made a commitment

to helping the handicapped access their computers. Many developments are in specialized hardware, but over the last two years Apple Computer's Office of Special Education has been accumulating a comprehensive database of information about hardware products and software programs that, when used with Apple products, provide disabled individuals with new options and opportunities. This information is now available in one book called, Apple Computer Resources in Special Education and Rehabilitation. This book also includes lists of publications and organizations all designed to help the disabled child and adult take advantage of the power of computing.

IBM has also been working on a variety of hardware and software adaptations for the handicapped populations. Although designed for speech therapy, the IBM SpeechViewer does provide a well-documented tool designed to increase the efficiency of speech therapy. It provides visual feedback which can motivate a student to participate. IBM also supports three programs by Micro-Interpreter and PC-Fingers that teaches and drills ASL finger spelling and signed words. The IBM Principle of the Alphabet Literacy System (PALS) has been evaluated to be an effective tool in teaching some adults to read and write. It is recommended, however, that it be part of a total program of instruction, since students who do not know the names of letters and sounds may have some difficulty (Njie & Cramer, 1988). Our low-level HI population may also find this too difficult.

There are many other software publishers and journals that evaluate software. The number of programs that really do more than drill are very limited. Any commercial developments must necessarily depend on research, feedback and evaluation from users to continue to improve the usefulness of hardware and software.

Institutional Development

As mentioned before, the **Chemeketa Community College** in Salem, Oregon, has their deaf students using computers to communicate via modem with other students nationwide. They also have equipment to allow the hearing and deaf students communicate. They mostly use the same software that they use in their regular basic skills program.

Gallaudet University, with the emphasis on the latest technology, is exploring much educational software and equipment for its application to the hearing impaired population. The Computer Project Survey (Mackall & Rush, 1988) collected data from 2,000 schools and programs for the hearing impaired in the U.S. and Canada, and has published a summary of those projects. These projects have been cross-indexed by age level, computer type, contact persons, and subject area. Many of the projects are designed to upgrade the skills of teachers, to diagnose reading levels for students, or to drill on basic skills. This book includes helpful information on other resources, library databases for further research and software evaluation centers. There really is no evaluation of how effective the programs are.

Some very creative projects are ongoing and use basic graphics

and word processing programs with teachers tailoring the instruction to individual students (Sheie & Hirsch, 1987). Storm (1987) also found that computers can greatly enhance the writing/editing process but require ongoing support from concerned teachers.

In a project by Spidal & Ryan (1987), at the **New York School for the Deaf**, middle school students had access to computers for writing assignments. One conclusion was that computer use should be encouraged for hearing impaired students and students should be allowed ample time to work at their own speed.

The **Penn State Adult Literacy Courseware** was developed with state administrative funds from Chapter I to improve the literacy skills of low literate parents so that they could better help their at-risk children who were enrolled in school Chapter I compensatory programs. This courseware for adult beginning readers was developed using a "whole word" approach with some word building activities in teaching 1,000 high frequency and functional words. The courseware is interactive, branching and responding to the user's answers and needs. In addition, Modules 3 and 6 can be customized by the teacher to include his/her own words and sentences. The courseware consists of several disks which deliver the instructional program and record student responses. A detailed teacher's manual provides instructions on use as well as suggestions for integrating the courseware into ongoing literacy instruction. The Institute for the Study of Adult Literacy and Gallaudet's ABE program are designing several studies to determine it's effectiveness in improving basic English writing and reading

for HI adults.

Individual Development

The National Special Education Alliance (NSEA) is a national network of local computer resource centers. Originally composed of eleven non-profit, parent-run sites, there are now more than 50 centers across the U.S. linked by a common passion: to use state-of-the-art technology to better the lives of individuals with disabilities, including the hearing impaired (Green, 1988). The Alliance conducts research and evaluation of hardware and software, especially as it relates to an individual's access to schools and the workplace. They also have a relationship with 50 to 60 vendors, including Apple Computer and IBM, who want feedback on the age appropriateness of software.

Networking and Cooperation Essential

As the Alliance shows, networking can help small centers keep up-to-date with developments in hardware and software. This model of networking must be expanded to include the latest research on adult literacy, the hearing impaired population, and computer technology. As has been shown, specialists in each area can assist other specialists, using the modem and computer itself.

The networks of literacy providers we have across the country can be accessed easily. For example, The Adult Literacy & Technology Project publishes a newsletter and conducts a national conference to keep literacy providers informed of the latest research. A growing number of State Coalitions for Adult Literacy also exist to assist in sharing adult literacy information. These

coalitions are linked through The State Literacy Initiative Network, and can share information nationally. In addition, literacy providers can be connected electronically, with AppleLink, nationwide. Information can be shared, questions answered, and problems explored very quickly using this network.

The Future

This network will be even more critical in the future. Some of the exciting developments on the horizon offer even more potential for bridging the gap to success for the low-literate, hearing impaired adult.

As defined by Bosco (1988) interactive video is simply a video source that is controlled by a computer. The two elements, audio-video (AV) and computer-assisted instruction (CAI), have been around for quite a while. The power and flexibility of microcomputer technology, along with refinements of video disc technology, produced an instructional tool that offers new opportunities.

Boothroyd (1987), mentions that the **National Technical Institute for the Deaf** has been using interactive video for several years, with programs for lipreading training, sign language training, and vocabulary development.

The **Alberta Vocational Center** has used a videodisc program to teach communication skills to persons working with HI students. With the student in control of branching to new material, or review of previous information, students' attitudes towards the system were very positive (Thorkildsen, 1985, p. 330).

Since 1980, the **California School for the Deaf at Riverside**

has served as one model for the practical application of interactive videodisc technology (Osksa, 1987). They have developed an authoring program that uses nine question types for the teaching of language tasks, compared to the simple true/false, multiple choice, or fill-in-the-blank questions originally used. Osksa (1987), reminds us that "most people think of interactive videodisc technology as the union of computers and videodisc players, forgetting that the third and most important ingredient is the student" (p. 86).

Although Bosco (1988) reminds us that although there is nothing intrinsic in the new technology that guarantees it will produce beneficial effects, it deserves serious consideration by those working with adult literacy. "Interactive video should serve as a catalyst for the imagination and enable us to design fresh new approaches that are based on a good understanding of who the learner is and how he or she learns" (p. 9).

Summary and Recommendations

It is now within our reach, as professionals, to help low-literate, hearing impaired adults bridge the gap between where they are now and where they would like to be--functional, literate adults in a modern world. Research can help us understand the underlying problems we face. Teachers can help us understand the reality of the student's needs. Computer companies know there is a market waiting to be tapped and are waiting for feedback on what we want. Networking can help us all build on each other's successes for the benefit of the low-literate, hearing impaired

adult. This networking should involve partnerships among commercial companies, universities, and service providers. Therefore, we recommend that literacy researchers and HI specialists:

1) continue research and development activities, building on current research in adult literacy and applying it to the HI population;

2) evaluate carefully the effectiveness of pilot projects;

3) encourage more teacher training and technical assistance in computer technology; and

4) communicate with ongoing projects and organizations across the country to share information.

REFERENCES

Anderson, R. C., Hiebert, E. H., Scott, J. A., & Wilkinson, I. A. G. (1984). Becoming a nation of readers: the report of the commission on reading. (Contract No. 400-83-0057).

Washington, DC: National Institute of Education. Applebee, A. N., Lehr, F., & Auten, A. (1981). Learning to write in the secondary school: How and where, English Journal, 70 (5), 78-82.

Askov, E. N. (1986). Evaluation of computer courseware for adult beginning reading instruction in a correctional setting. Final Report. (Available from ADvancE, PDE Resource Center, Harrisburg, PA).

Askov, E. N. & Brown, E. J. (1988). Attitudes of adult literacy students and their teachers toward computers for instruction: before and after use. Yearbook of the American Reading Forum. Muncie, IN: Ball State University.

Askov, E. N., Maclay, C. M., & Bixler, B. (1987). Final report. Penn State adult literacy courseware: Impact on parents and children. University Park, PA: Institute for the Study of Adult Literacy.

Askov, E. N. & Turner, T. C. (1989). Using computers for teaching basic skills to adults. Lifelong Learning, 12(6), 28-31.

Askov, E. N. & Otto, W. (1985). Meeting the challenge: Corrective reading instruction in the classroom. Columbus, OH: Charles E. Merrill.

Belasco, S. (1981). Aital cal aprene las estrangieras. In H. Winitz (Ed.). The comprehension approach to foreign language instruction. Rowley, MA: Newbury House.

Bixler, B. & Askov, E. N. (1988). Use of computer-assisted instruction with displaced workers and volunteer tutors (Final Report). University Park: Institute for the Study of Adult Literacy, Penn State University.

Boothroyd, A. (1987). Technology and science in the management of deafness. American Annals of the Deaf, 132(5) 326-329.

Bosco, J. J. (1988). Three conclusions on interactive video. Adult Literacy and Technology Newsletter, 2 (1) 8-9.

Carter-Williams, M. (1988). 1988 National conference on adults with special learning needs. (p. 4). Washington, D.C.: Gallaudet University.

Chall, J. S. (1984, January). New views on developing basic skills with adults. Paper prepared for the National Conference on Adult Literacy. Washington, D.C.
Clark, R. E. (1983). Reconsidering research on learning from media. Review of Educational Research, 53 (4), 445-459.

Collino, G. E., Aderman, E. M., & Askov, E. N. (1988). Literacy and job performance: A perspective. The Pennsylvania State University: The Institute for the Study of Adult Literacy.
Commission on Education of the Deaf (1988). Toward Equality: Education of the Deaf: A report to the President and the Congress of the United State, February, 1988. The Commission on Education of the Deaf: U. S. Department of Education.

Dequin, H. C. & Johns, J. L. (1986). Literacy materials and support services in Canada and the U. S. for hearing impaired persons. Journal of Reading, 29, 746-50.

Dunkel, P. A. (1986). Developing listening fluency in L2: Theoretical principles and pedagogical considerations, The Modern Language Journal, 70(2), 100-106.

Egan, K. (1985). Software adaptations for the multi-handicapped: a case study. American Annals of the Deaf, 130(5) 421-423.

Ehrlich, J. (1988). 1988 National conference on adults with special learning needs. (p. 10). Washington, D.C.: Gallaudet University.

Fleharty, J. (1985). Software for English, Mathematics, and Elementary classes. American Annals of the Deaf, 130(5) 362-370.

Gallaudet Research Institute (date?). Distinguishing Code Switching and Code-mixing in English to ASL interpretation. Research at Gallaudet: A Newsletter by the Gallaudet Research Institute. pp 9-10.

Gallaudet University. (May 21, 1987). Illiteracy Among Deaf Persons. (Unpublished paper).

Garvey, M. (1985). Authoring computer lessons - it's easy! American Annals of the Deaf, 130(5) 354-356.

Goodman & Goodman. (1981). A whole language, comprehension-centered reading program: A position paper. Phoenix, AZ: University of Arizona, Tucson College of Education.

Goudreau, N. (1986). Improve your adult literacy instruction by vitalizing the research: Part II. Lifelong Learning: An Omnibus of Practice and Research, 10 (14), 11-14.

Graves, D. H. (1983). Writing: Teachers and children at work. Portsmouth, NH: Heinemann Educational Books.

Green, P. (1988). The National special education alliance: One year later. Exceptional Parent, October, 1988. 48-55.

Harman, D. (1985). Turning illiteracy around: An agenda for national action. Working paper no. 2. New York: Business Council for Effective Literacy.

Hart-Davis, Sandra R. (1985). The Classroom Computer as a Partner in Teaching Basic Skills to Hearing-Impaired Children. American Annuals of the Deaf, 130(5), 410-414.

Hewitt, A. (1978). Adult literacy and the Student. London: Adult Literacy Resource Center.

Howard, V. A. & Barton, J. H. (1986). Thinking on paper. New York: William Morrow.

Imel, S. (1989). Computer-assisted instruction in adult literacy education. Centergram (Center on Education and Training for Employment, The Ohio State University). XXIV(2) 1,3.

Institute for the Study of Adult Literacy. (1988). Adult Literacy & Technology Project. Penn State University, University Park, PA 16801.

Kean, J. M. (1983). The teaching of reading in our schools. Bloomington, IN: Phi Delta Kappa Foundation.

King & Quigley. (1985). Citation in Illiteracy Among Deaf Persons, Gallaudet University publication, May 21, 1988.
Kirsch, I. S. & Jungeblut, A. (1986). Literacy: Profiles of America's young adults. (Report No. 16-PL_02). Princeton, NJ: Educational Testing Service.

Lewis, L. H. (1988). Adults and computer anxiety: fact or fictio n? Lifelong Learning, 11(8), 5 - 8, 12.

MacDonald, L. (April 12, 1989). Personal communication by electronic mail (AppleLink). Chemeketa Community College, Salem Oregon.

Mackall, P. & Rush, L. (1988). Computer Projects Survey. Washington, DC: Gallaudet University.

Maclay, C. (1986). An investigation of the use of computer-assisted instruction in teaching sign word recognition to adult beginning readers in a prison setting. Unpublished doctoral dissertation, Pennsylvania State University, PA.

Maclay, C. M. & Askov, E. N. (1987). Computer-aided instruction for Mom and Dad. Issues in science and technology, 4 (1), 88-91.

Maclay, C. M. & Askov, E. N. (1988). Computers and adult beginning readers: an inter-generational study. Lifelong Learning, 11(8), 23-25, 28.

McCune, D. & Alamprese, J. (1985). Turning illiteracy around: An agenda for national action, Working Paper No. 1. New York: Business Council for Effective Literacy.

Messerly, C. (1986). The use of computer-assisted instruction in facilitating the acquisition of math skills with hearing-impaired high school students. The Volta Review, 88(2) 67-77.

Murray, D. M. (1984). Write to learn. New York: Holt, Rinehart & Winston.

Myers, J. W. (1984). Writing to learn across the curriculum. Bloomington, IN: Phi Delta Kappa Foundation.

Njie, V. & Cramer, E. (1988). Bidwell pre-computer literacy program: An evaluation of IBM's Principle of the Alphabet Litera cy System (PALS). (Available from ADvancE, PDE Resource Center, Harrisburg, PA). Pittsburgh, PA: Bidwell Training Center, Inc.

Office of Technology Assessment. (1987). Trends and status of computers in schools: Use in Chapter I programs and use with limited English proficient students. Washington, DC: Author.
Osksa, R. S. (1987). When computers talk to videodiscs. In Abrams, M. (Ed.) Your computerized classroom: Using computers with hearing impaired students., pp. 77-86. Washington, DC: Gallaudet University.

Papagiannis, G. J., Douglas, C., Williamson, N. & LeMon, R. (1987). Information technology and education: Implications for theory, research, and practice. Ottawa, Canada: International Development Research Center.

Pastori, S. (1986). Literacy for every adult project (LEAP). Report of Learning Center Component. (Available from Richmond Public Library. Richmond, California).

Potovsky. (1981). The priority of aural comprehension in the language acquisition process. In H. Winitz (Ed.). The comprehension approach to foreign language instruction.

Rowley, MA: Newbury House. Presseisen, B. Z. (1986). Thinking skills: Research and practice. Washington, DC: National Educat ion Association.

Prewitt-Diaz, J. (1985). Teaching reading to bilingual students in the content classroom, in E. N. Askov & W. Otto (Eds.). Meeting the challenge: Corrective reading instruction in the classroom. Columbus, OH: Charles E. Merrill.

Prinz, P. M., Pemberton, E., & Nelson, K. E. (November, 1985). The ALPHA Interactive Microcomputer System for Teaching Reading, Writing, and Communication Skills to Hearing-Impaired Children. American Annuals of the Deaf, 130(5), 444-461.

Rubin, A. & Hansen, J. (1985). Reading and writing: How are the first two 'Rs' related? In Reading comprehension: From research to practice, edited by J. Orasanu. Hillsdale, NJ: Erlbaum.

Segalman, R. (1981). Poverty in America: the welfare dilemma. Connecticut: Greenwood Press.

Sheie, T. P. & Hirsch, J. (1987). What's new in Newsroom: Software for the language arts. In Abrams, M. (Ed.) Your computerized classroom: Using computers with hearing impaired students., pp. 41-47. Washington, DC: Gallaudet University.

Sticht, T. M. (1987). Functional context education: Workshop resource notebook. San Diego, CA: Applied Behavioral & Cognitive Sciences, Inc.

Storm, R. D. (1987). Computers and the writing process. In Abrams, M. (Ed.) Your computerized classroom: Using computers with hearing impaired students., pp. 55-64. Washington, DC: Gallaudet University.

Spidal, K. M. & Ryan, G. R. (1987). Drop those pencils! Computers in writing development. In Abrams, M. (Ed.) Your computerized classroom: Using computers with hearing impaired students., pp. 33-39. Washington, DC: Gallaudet University.

Thompson, W. W. (1985). Environmental effects on educational performance, The Alberta Journal of Educational Research, 31(1).

Thorkildsen, R. (1985). Microelectronic technology and the hearing impaired: The future. American Annals of the Deaf, 130(5) 324-331.

Trachtenberg, R. (1985). Computer applications in deaf education, in Conference Proceedings of Computer Technology and Persons with Disabilities (Northridge, CA: October, 1985).

Trybus, R. J., & Karchmer, M. A. (1977). School achievement scores of hearing impaired children: National data on achievemen t status and growth patterns. American Annals of the Deaf Directory of Programs and Services, 172, 62-69.

Turkle, S. (1984). The second self. New York: Simon & Shuster.
Turner, T. C. (1988). Adult literacy & technology: Visions for the future. Adult Literacy & Technology Newsletter, 2(2) 1-3.
Turner, T. C. & Stockdill, S. H. (Eds.) (1987). The technology for literacy project evaluation. St.Paul, MN: St. Paul Foundation.

Venezky, R. L., Kaestle, C. F., & Sum, A. M. (1987). The subtle danger. Reflections on the literacy ability of young adults. ETS Report No. 16-CAEP-01. Princeton, NJ: Educational Testing Service.

Webster, A. (1986). Deafness, Development and Literacy. New York: Methuen.

Winitz, H. (1981). A reconsideration of comprehension and production in language training. In H. Winitz (Ed.). The comprehension approach to foreign language instruction. Rowley, MA: Newbury House.

Young, M. (1985). Faculty computer workshops: a faculty becoming computer literate. American Annals of the Deaf, 130(5) 347-353.